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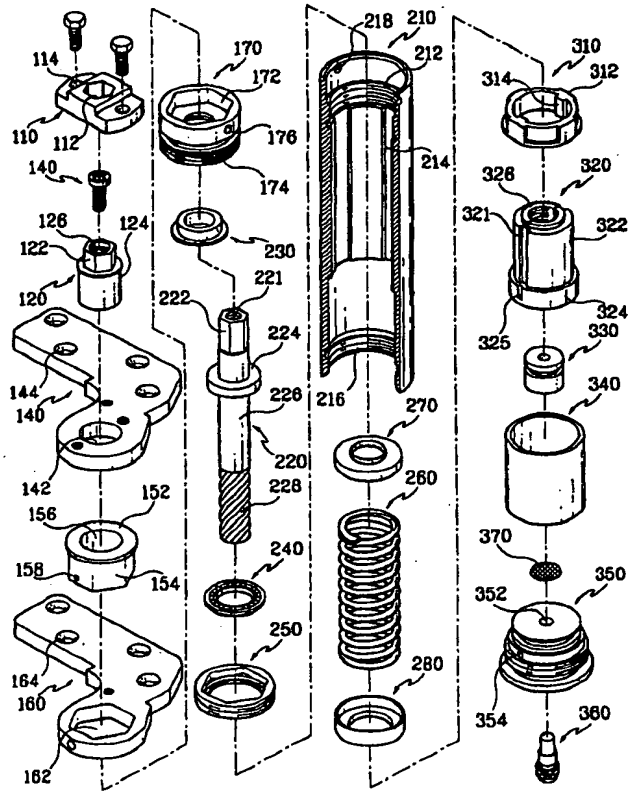
(54) Title: DOOR HINGE DEVICE HAVING DAMPING FUNCTION



(57) Abstract: Disclosed is a door hinge device having a damping function. Owing to cooperation of an adjusting bolt, an upper holder and a shaft, the door hinge device can properly adjust a size of a gap defined between a fixed plate and a rotating plate when the size varies, for example, due to a discrepancy in specifications between a door and a doorframe. By the presence of a ball bearing, the door hinge device can minimize frictional force produced between component elements so that a lifetime of the door hinge device is lengthened and various springs can be used in the door hinge device irrespective of their elastic moduli.

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DOOR HINGE DEVICE HAVING DAMPING FUNCTION

Technical Field

The present invention relates to a door hinge device, and more particularly, the present invention relates to a door hinge device having a damping function, which is capable of properly maintaining an opening and closing velocity of a door.

Background Art

Generally, a door is rotatably connected to a doorframe by means of a door hinge device having a damping function. Such a door hinge device serves to properly maintain an opening and closing velocity of a door and thereby prevent an accident from occurring due to quick opening and closing of the door. Further, the door hinge device allows the door to be automatically closed once being opened.

A typical example of a door hinge device having a damping function is disclosed in Korean Patent Laid-open Publication No. 1999-81808 entitled "Door Hinge". This door hinge includes a housing. An oil pressure adjusting body is integrally formed at a side of the housing, and a hinge shaft is centrally disposed in the housing. A cap-shaped connector is fitted into an upper end of the housing. A door mounting plate is locked to an upper end of a door and fastened to the housing. A doorframe mounting plate is threadedly coupled to the connector and locked thereto by a nut, and fastened to a doorframe. The hinge shaft centrally disposed in the housing is inserted through the connector to be secured with respect to the doorframe. The hinge shaft functions to raise and lower a piston. The piston is raised and lowered, by rotation of the housing, along the hinge shaft in a cylinder chamber which is filled with oil. The piston

serves as a check valve. A spring is arranged underneath the piston to apply elastic force thereto. A cap is threadedly coupled to a lower end of the housing. An adjusting valve is disposed in the oil pressure adjusting body to control an amount of oil circulated through passages and oil paths.

The conventional door hinge device constructed as mentioned above suffers from defects in that it does not have any means for compensating a variation in size of a gap defined between the door mounting plate and the doorframe mounting plate, which variation may be caused due to a discrepancy in specifications between the door and the doorframe. Also, because frictional force is generated to a great extent between the hinge shaft and component elements disposed in the housing, a spring having an elastic modulus of no less than a predetermined value should be necessarily used.

Disclosure of the Invention

Accordingly, the present invention has been made in an effort to solve the problems occurring in the related art, and an object of the present invention is to provide a door hinge device having a damping function, which can properly adjust a size of a gap defined between a fixed plate and a rotating plate when the size varies, for example, due to a discrepancy in specifications between a door and a doorframe, and which can minimize frictional force produced between component elements so that a lifetime of the door hinge device is lengthened and various springs can be used in the door hinge device irrespective of their elastic moduli.

In order to achieve the above object, according to the present invention, there is provided a door hinge device installed between a door and a doorframe for allowing the door to be automatically closed once being opened and adjusting an opening and closing velocity of the door, the door hinge device comprising:

an adjusting plate having defined therethrough a polygonal hole; an upper holder having a polygonal head inserted into the polygonal hole of the adjusting plate and a cylindrical holder body integrally formed at a lower end of the polygonal head, the upper holder possessing a threaded hole which is defined through the polygonal head and the holder body; an adjusting bolt inserted through the adjusting plate and the upper holder; a fixed plate fastened to the doorframe and having an upper holder hole through which the upper holder is fitted; a lower holder having an annular plate portion an upper surface of which is brought into contact with the fixed plate and a polygonal body which is integrally formed with and extends downward from the annular plate portion, the lower holder possessing a through-hole which is defined through the annular plate portion and the polygonal body; a rotating plate fastened to the door and having a polygonal lower holder hole through which the polygonal body of the lower holder is fitted; an upper ring having defined on an upper surface thereof a polygonal groove in which the polygonal body of the lower holder is received, the upper ring further having formed on a circumferential outer surface adjacent to a lower end thereof an externally threaded portion; a housing integrally rotated with the rotating plate and having a first internally threaded portion which is formed on a circumferential inner surface adjacent to an upper end of the housing, guide grooves which are defined to extend downward from the first internally threaded portion by a predetermined length, and a second internally threaded portion which is formed on the circumferential inner surface adjacent to a lower end of the housing; a shaft disposed in the housing and having a polygonal rod portion, an outward flange which is formed at a lower end of the polygonal rod portion, a circular rod portion which is formed at a lower end of the outward flange and a threaded rod portion which is formed at a lower end of the circular rod portion, the polygonal rod portion being defined on an upper surface thereof with a

tapped groove into which the adjusting bolt is threaded; a ball bearing positioned underneath the outward flange of the shaft, for reducing friction between the shaft and the housing; a lower ring threadedly coupled to the first internally threaded portion of the housing, for supporting the ball bearing; a spring arranged underneath the lower ring in the housing; a slider slid in upward and downward directions upon rotation of the housing while supporting a lower end of the spring, the slider possessing a ring-shaped configuration and having outward guide protrusions which are formed on a circumferential outer surface of the slider to be slidably fitted into the guide grooves, respectively, of the housing and inward guide protrusions which are formed on a circumferential inner surface of the slider; a piston having a small diameter portion, a large diameter portion and a shaft coupling portion, the small diameter portion having defined on a circumferential outer surface thereof slider guide grooves into which the inward guide protrusions of the slider are respectively fitted, the large diameter portion being integrally formed at a lower end of the small diameter portion, and the shaft coupling portion being installed on an upper end of the small diameter portion in a manner such that the threaded rod portion of the shaft is threadedly coupled to the shaft coupling portion; a check valve fitted into the piston, for preventing backflow of oil; a cylinder fitted into the housing in a manner such that the piston is disposed in the cylinder; and a cap threaded into the second internally threaded portion of the housing, for supporting the piston and the cylinder.

Brief Description of the Drawings

The above objects, and other features and advantages of the present invention will become more apparent after a reading of the following detailed description when taken in conjunction with the drawings, in which:

FIG. 1 is an exploded perspective view illustrating an entire construction of a door hinge device having a damping function in accordance with an embodiment of the present invention; and

FIG. 2 is a cross-sectional view illustrating an assembled status of the door hinge device according to the present invention.

Best Mode for Carrying Out the Invention

Reference will now be made in greater detail to a preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description to refer to the same or like parts.

As shown in FIGs. 1 and 2, a door hinge device having a damping function in accordance with an embodiment of the present invention includes an adjusting plate 110, an upper holder 120, an adjusting bolt 130, a fixed plate 140, a lower holder 150, a rotating plate 160, an upper ring 170, a housing 210, a shaft 220, a bushing 230, a ball bearing 240, a lower ring 250, a spring 260, an upper spring cap 270, a lower spring cap 280, a slider 310, a piston 320, a check valve 330, a cylinder 340, a cap 350, an oil pressure adjusting screw 360 and a filter 370.

The adjusting plate 110 connects the upper holder 120 and the fixed plate 140 with each other. The adjusting plate 110 has defined therethrough a polygonal hole 112 and a pair of locking holes 114 which are positioned at both sides of the polygonal hole 112, respectively. A separate cover may be placed on the adjusting plate 110.

The upper holder 120 connects the fixed plate 140 and the lower holder 150 with each other. The upper holder 120 has a polygonal head 122 which is inserted into the polygonal hole 112 of the adjusting plate 110 and a cylindrical

holder body 124 which is integrally formed at a lower end of the polygonal head 122. The upper holder 120 possesses a threaded hole 126 which is defined through the polygonal head 122 and the holder body 124.

The adjusting bolt 130 serves as means for adjusting a size of a gap defined between the fixed plate 140 and the rotating plate 160 when the size varies, for example, due to a discrepancy in specifications between a door and a doorframe. The adjusting bolt 130 passes through the polygonal hole 112 and the threaded hole 126 and is threaded into a tapped groove 221 of the shaft 220. Accordingly, if the adjusting bolt 130 is rotated, as the shaft 220 is also rotated in the same direction, a vertical position of the shaft 220 in the housing 210 can be changed.

The fixed plate 140 is fastened to the doorframe. The fixed plate 140 has an upper holder hole 142 through which the upper holder 120 is fitted, and a plurality of locking holes 144 through which bolts can pass to fasten the fixed plate 140 to the doorframe.

The lower holder 150 connects the upper holder 120, the rotating plate 160 and the upper ring 170 one with another. The lower holder 150 has an annular plate portion 152, an upper surface of which is brought into contact with the fixed plate 140, and a polygonal body 154 which is integrally formed with and extends downward from the annular plate portion 152. The lower holder 150 possesses a through-hole 156 which is defined through the annular plate portion 152 and the polygonal body 154. A pair of assembling holes 158 are respectively defined at both sides of the lower holder 150 to extend in a radial direction.

The rotating plate 160 is fastened to the door. The rotating plate 160 is coupled to the housing 210 by the medium of the lower holder 150 and the upper ring 170. The rotating plate 160 has a polygonal lower holder hole 162 through

which the polygonal body 154 of the lower holder 150 is fitted, and a plurality of locking holes 164 through which bolts can pass to fasten the rotating plate 160 to the door.

The upper ring 170 connects the lower holder 150 and the housing 210 with each other. The upper ring 170 has defined on an upper surface thereof a polygonal groove 172 in which the polygonal body 154 of the lower holder 150 is received. The upper ring 170 further has formed on a circumferential outer surface adjacent to a lower end thereof an externally threaded portion 174 which is coupled to a first internally threaded portion 212 of the housing 210. A pair of assembling holes 176 are respectively defined at both sides adjacent to an upper end of the upper ring 170 to extend in the radial direction. An O-ring 178 is fitted around the upper ring 170 directly above the externally threaded portion 174.

The housing 210 serves as a main body of the door hinge device having a damping function, which main body constitutes a characterizing feature of the present invention. The housing 210 has the first internally threaded portion 212 which is formed on a circumferential inner surface adjacent to an upper end of the housing 210, guide grooves 214 which are defined to extend downward from the first internally threaded portion 212 by a predetermined length, and a second internally threaded portion 216 which is formed on the circumferential inner surface adjacent to a lower end of the housing 210. A pair of assembling holes 218 are respectively defined at both sides adjacent to the upper end of the housing 210 to extend in the radial direction. Each guide groove 214 is defined between two guide projections, and these guide projections are only formed over approximately an upper half of the housing 210. According to this, approximately a lower half of the housing 210 has the circumferential inner surface which is coplanar with bottom surfaces of the guide grooves 214.

Upward movement of the slider 310 in the housing 210 is limited by the guide projections. The housing 210 is integrally rotated with the rotating plate 160.

The shaft 220 is disposed in the housing 210 to raise and lower the slider 310 and the piston 320 upon opening and closing of the door. The shaft 220 has a polygonal rod portion 222, an outward flange 224 which is formed at a lower end of the polygonal rod portion 222, a circular rod portion 226 which is formed at a lower end of the outward flange 224 and a threaded rod portion 228 which is formed at a lower end of the circular rod portion 226. The polygonal rod portion 222 is defined on an upper surface thereof with a tapped groove 221 into which the adjusting bolt 130 is threaded. The shaft 220 is not integrally rotated with the rotating plate 160 and the housing 210, and instead, is only moved in upward and downward directions by rotation of the adjusting bolt 130.

A bushing 230 functions to prevent direct contact between the upper ring 170 and the shaft 220. The bushing 230 is arranged between the outward flange 224 of the shaft 220 and the upper ring 170.

The ball bearing 240 functions to prevent direct contact between the shaft 220 and the lower ring 250 in the housing 210, and constitutes another characterizing feature of the present invention. The ball bearing 240 is positioned underneath the outward flange 224 of the shaft 220 in a state wherein it is fitted into the lower ring 250. The ball bearing 240 is arranged between the shaft 220 and the lower ring 250, that is, at a place where frictional force is produced to a great extent by a torsional load applied to the spring 260 and the piston 320 upon rotation of the door. Therefore, the ball bearing 240 plays an important role of reducing the frictional force between the component elements. In the conventional door hinge device, a spring having an elastic modulus of no less than a predetermined value should be necessarily used due to frictional force produced between the lower ring and the shaft upon rotation of the housing.

However, in the door hinge device according to the present invention, due to the fact that the ball bearing 240 reduces frictional force between the lower ring 250 and the shaft 220 in the housing 210, various springs can be used irrespective of their elastic moduli.

The lower ring 250 supports the ball bearing 240 and is threadedly coupled to the first internally threaded portion 212 of the housing 210. An upper surface of the lower ring 250 is brought into contact with a lower surface of the upper ring 170.

The spring 260 provides returning force so that the door is automatically closed once being opened. The spring 260 is arranged underneath the lower ring 250 in the housing 210. When the door is opened, the spring 260 is compressed by the piston 320 to accumulate therein elastic energy. Then, when external force applied to the door is removed, the spring 260 transfers the accumulated elastic energy to the door so that the door is automatically closed.

The upper spring cap 270 and the lower spring cap 280 are respectively fitted around an upper end and a lower end of the spring 260. The upper and lower spring caps 270 and 280 function to prevent direct contact between the spring 260 and the component elements which are positioned over and under the spring 260.

The slider 310 is moved on the circumferential inner surface of the housing 210 in the upward and downward directions while being guided by the guide grooves 214. The slider 310 possesses a ring-shaped configuration and has outward guide protrusions 312 which are formed on a circumferential outer surface of the slider 310 to be slidably fitted into the guide grooves 214, respectively, of the housing 210 and inward guide protrusions 314 which are formed on a circumferential inner surface of the slider 310 to be slidably fitted into slider guide grooves 321, respectively, of the piston 320. The slider 310 is

slid in the upward and downward directions by movement of the piston 320 upon rotation of the housing 210.

The piston 320 is raised and lowered in the housing 210 by rotation of the housing 210. The piston 320 has a small diameter portion 322, a large diameter portion 324 and a shaft coupling portion 326. The small diameter portion 322 has defined on a circumferential outer surface thereof the slider guide grooves 321 into which the inward guide protrusions 314 of the slider 310 are respectively fitted. The large diameter portion 324 is integrally formed at a lower end of the small diameter portion 322. The shaft coupling portion 326 is installed on an upper end of the small diameter portion 322 in a manner such that the threaded rod portion 228 of the shaft 220 is threadedly coupled to the shaft coupling portion 326. An oil groove 325 is defined at a side of the large diameter portion 324.

In the case that it is difficult to form the shaft coupling portion 326 integrally with the large diameter portion 324, the shaft coupling portion 326 may be separately formed and press-fitted into the large diameter portion 324. As the housing 210 is rotated upon opening of the door, the piston 320 is moved upward and compresses the spring 260. Thereafter, as the door is closed, the piston 320 is moved downward to decompress the spring 260.

The check valve 330 is fitted into the piston 320, for preventing backflow of oil. The check valve 330 has a ball 332. When the door is closed, the ball 332 prevents backflow of oil in the check valve 330, whereby the damping function of the door hinge device according to the present invention is accomplished.

The cylinder 340 is fitted into the housing 210 in a manner such that the piston 320 is disposed in the cylinder 340. The cylinder 340 defines a path along which the piston 320 is moved upward and downward. Due to the fact

that the cylinder 340 is formed by compressing, drawing and coating processes, airtightness is maintained between the cylinder 340 and the piston 320 without using any separate packing member. The cylinder 340 has an inner diameter which is gradually and micro-dimensionally increased from an upper end 342 toward a lower end 344 of the cylinder 340. Thus, when the piston 320 is lowered, oil flows fast through the oil groove 325 at a preset position of the door, that is, at a closing position of the door, in such a way as to increase a door closing velocity while continuously maintaining an oil pressure.

The cap 350 seals a lower end of the housing 210. The cap 350 supports a lower end of the cylinder 340 and is threaded into the second internally threaded portion 216 of the housing 210. The cap 350 is defined with an oil pressure adjusting hole 352 and an oil discharge hole 354. O-rings 356 for preventing oil leakage are fitted around the cap 350 adjacent to upper and lower ends, respectively, of the cap 350. In a specified application, an opening and closing velocity of the door can be adjusted by rotating the cap 350.

An oil pressure adjusting screw 360 is threaded into the oil pressure adjusting hole 352 of the cap 350. The oil pressure adjusting screw 360 functions to adjust an internal oil pressure by being rotated and thereby changing a cross-section of an oil passage. The oil is circulated in the housing 210 through the spring 260, the inside of the piston 320, the oil pressure adjusting hole 352 and the oil discharge hole 354 of the cap 350, and the outside of the piston 320.

The filter 370 is located on an upper end of the oil pressure adjusting hole 352. The filter 370 functions to filter impurities contained in oil which flows through the check valve 330 toward the cap 350, and thereby lengthen a term of validity of the oil.

Hereafter, an assembling procedure of the door hinge device having a

damping function according to the present invention will be described.

First, the adjusting plate 110, the upper holder 120 and the fixed plate 140 are coupled one with another, and then, the fixed plate 140 is fastened to the doorframe using bolts. Thereafter, the upper holder 120 is inserted into lower holder 150. After the lower holder 150 passes through the through-hole 156 of the rotating plate 160, the rotating plate 160 is fastened to the door.

Then, the upper ring 170, bushing 230, ball bearing 240, lower ring 250, upper spring cap 270, spring 260 and the lower spring cap 280 are fitted around the shaft 220, and the resultant combination is disposed in the housing 210. The slider 310, the piston 320 having the check valve 330 and the cylinder 340 are coupled one with another, and the resultant combination is also disposed in the housing 210. Then, the cap 350 is threaded into the second internally threaded portion 216 of the housing 210. Thereupon, the housing 210 is joined to the lower holder 150 which is fitted into the rotating plate 160, and then, bolts are locked through the assembling holes 158 of the lower holder 150, the assembling holes 176 of the upper ring 170 and the assembling holes 218 of the housing 210.

Industrial Applicability

As apparent from the above description, the door hinge device having a damping function according to the present invention provides advantages in that, owing to cooperation of an adjusting bolt, an upper holder and a shaft, the door hinge device can properly adjust a size of a gap defined between a fixed plate and a rotating plate when the size varies, for example, due to a discrepancy in specifications between a door and a doorframe. Also, by the presence of a ball bearing, the door hinge device can minimize frictional force produced between component elements so that a lifetime of the door hinge device is lengthened and various springs can be used in the door hinge device irrespective of their elastic

FIG. 1

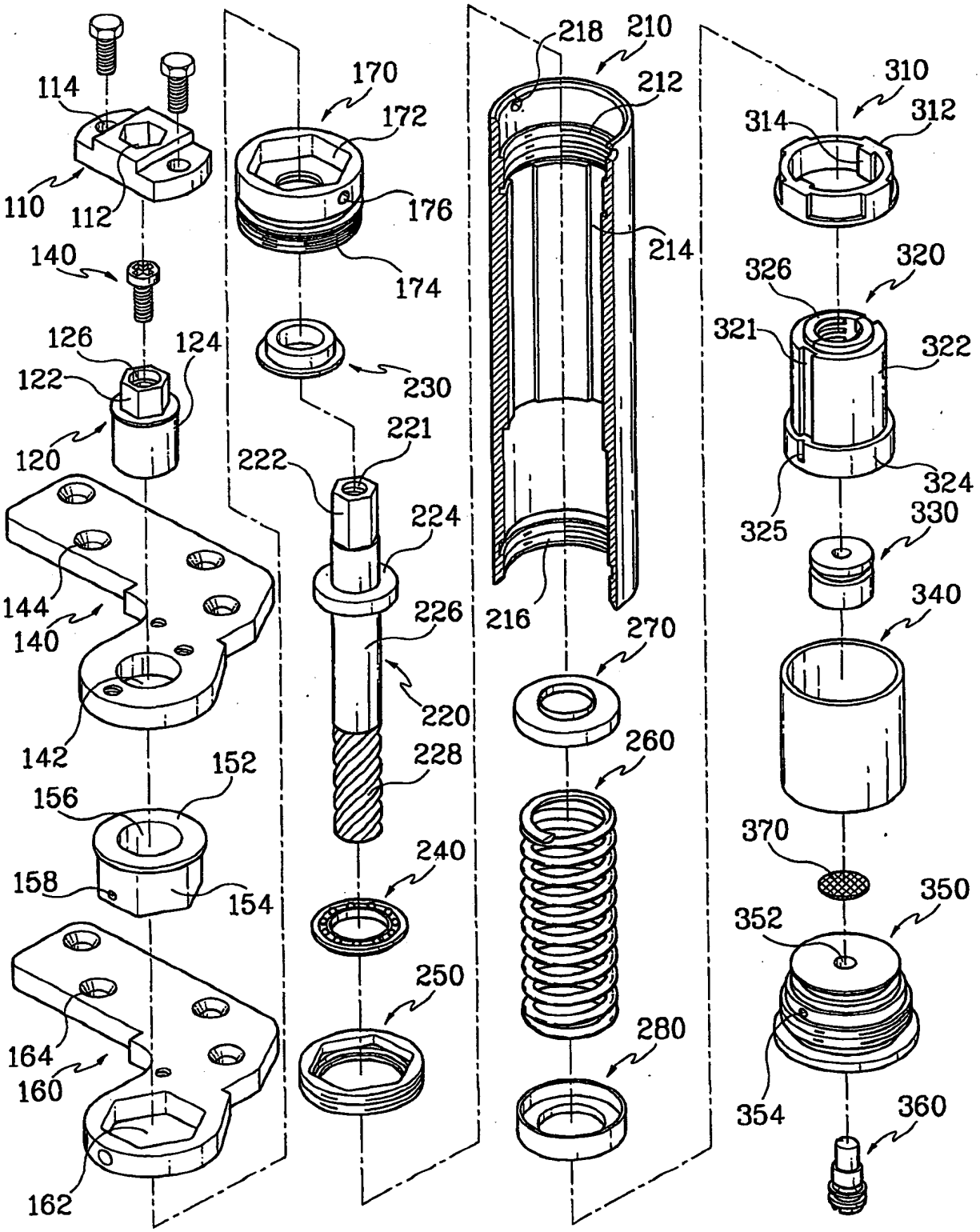
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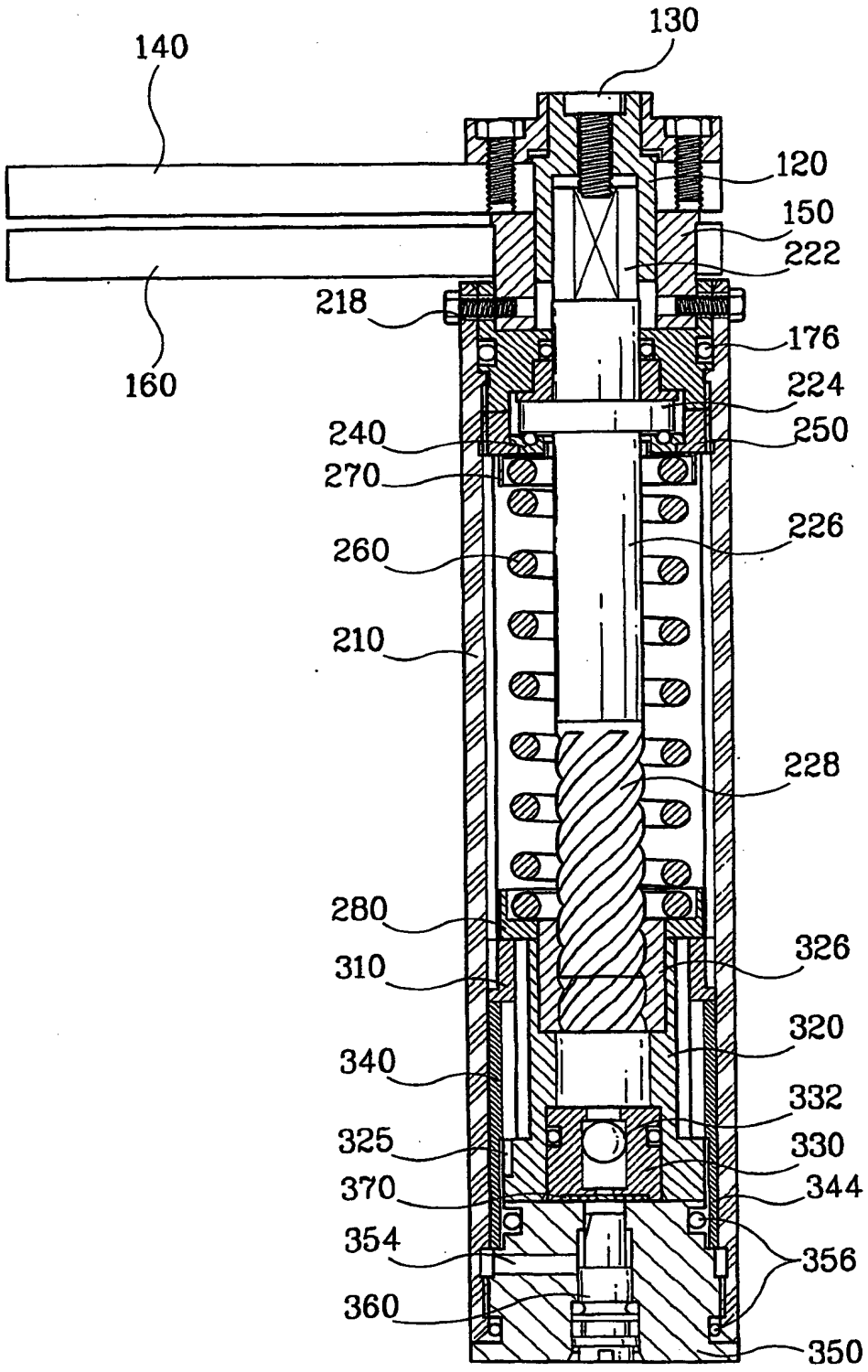
FIG. 2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